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840.01 General

Illumination is provided along highways, in parking lots, and at other facilities to enhance visual perception of conditions or features that require additional driver, cyclist, or pedestrian alertness during the hours of darkness.

The Washington State Department of Transportation (WSDOT) is responsible for illumination on state highways and crossroads (as per WAC 468-18-050) with partial, modified, or full limited access control regardless of the location and on state highways located outside the corporate limits of cities. Cities are responsible for illumination of state highways within their corporate limits but outside of WSDOT limited access control.

840.02 References

Revised Code of Washington (RCW) 47.24.020, "Jurisdiction, control."

Washington Administrative Code (WAC) 468-18-040, "Design standards for rearranged county roads, frontage roads, access roads, intersections, ramps and crossings"

Washington Administrative Code (WAC) 468-18-050, "Policy on the construction, improvement and maintenance of intersections of state highways and city streets"

Directive D 22-21, "Truck Weigh Stations and Vehicle Inspection Facilities on State Highways"

Roadway Lighting Handbook, Federal Highway Administration, Implementation Package 78-15, Washington, D.C. 1978 (Reprinted April 1984)

Roadway Lighting Handbook, Addendum to Chapter Six: Designing the Lighting System Using Pavement Luminance, Federal Highway

Administration, Addendum to Implementation Package 78-15, Washington, D.C. 1983

An Informational Guide for Roadway Lighting, AASHTO, Washington, DC 1984

American National Standard Practice for Roadway Lighting, IES RP-8-1983, New York, NY 1983

Recommended Practice for Tunnel Lighting, IESNA RP-22-96, New York, NY 1996

National Electrical Code, NFPA, Quincy, MA

City Streets as a Part of the State Highway - Final Report, WSDOT 1997

Standard Plans for Road, Bridge, and Municipal Construction (Standard Plans), M 21-01 WSDOT

840.03 Definitions

footcandle The illumination of a surface one square foot in area on which is uniformly distributed a flux of one lumen. A footcandle equals one lumen per square foot.

lamp lumens The total light output from a lamp in lumens. (A lumen being a unit of luminous flux.)

luminance Luminous intensity per unit projected area of any surface, as measured from a specific direction. The units of luminance are footcandles. Roadway luminance is the light projected from a luminaire that travels toward a given area, represented by a point on the pavement surface and then back towards the observer, opposite to the direction of travel.

luminous flux The time rate of flow of light.

maximum veiling luminance ratio This ratio is the maximum veiling luminance divided by the average luminance over a given design area for an observer traveling parallel to the roadway center line. The maximum veiling luminance ratio is 0.3:1.

minimum light level The minimum light intensity of illumination at any single point within the design area measured just prior to relamping the system.

minimum average light level The average of all light intensities within the design area measured just prior to relamping the system.

mounting height The vertical distance between the surface of the design area and the center of the light source of the luminaire. This is the distance used to compute the light level of the design area.

pole height (H1) The vertical distance from the light source to the pole base. This distance is specified in contracts and used by the pole manufacturers to fabricate the light standard. In curb and sidewalk areas, the H1 distance is assumed to equal the mounting height. Typically, the mounting height in fill sections is less than the H1 distance while the mounting height in cut sections is equal to or greater than the H1 distance.

security lighting A minimal amount of lighting used to illuminate areas for public safety or theft reduction. Security lighting for walkways is the lighting of angle points and shadow areas.

spacing The distance in feet measured on center line between adjacent luminaires.

uniformity ratio The ratio of the minimum average light level on the design area to the minimum light level of the same area.

veiling luminance The stray light produced within the eye by the light source that alters the apparent brightness of an object within the visual field and the background against which it is viewed. Conceptually, veiling luminance is the light that travels directly from the luminaire to the observers eye.

840.04 Required Illumination

The design matrices identify the design levels for illumination on all preservation and improvement projects. (See Chapter 325.) These levels, basic or full, are indicated in the columns.

At the basic design level for minor safety or preservation work, providing breakaway features on existing light standards (when required), replacing deficient electrical components, and other minor work would be the extent of consideration. Providing additional lighting or relocating light standards on preservation projects may be considered as a spot safety enhancement.

A full design level notation in a design matrix column indicates that the required illumination specified in this chapter is necessary. When the illumination column has an EU (evaluate upgrade to full design level), consider providing illumination if it would be beneficial to the specific project and document accordingly.

Figures 840-1 through 840-5 show examples of illumination for highway applications. Illumination in these examples and the locations listed below are required on state highways.

For Minor Operational Enhancement projects using the design matrices in Chapter 340, illumination is not required.

(1) Freeway Off-Ramps and On-Ramps

Provide the necessary number of light standards to illuminate the design area of all freeway off-ramp gore areas and on-ramp acceleration tapers. See 840.06(2).

(2) Freeway Ramp Terminals

A single light standard is required at the intersection of a ramp terminal with a two-lane roadway. At the intersection of a ramp terminal with a multilane roadway, additional lighting is required to illuminate the intersection design area. See Figure 840-5. Additional illumination is also required if the intersection has left-turn channelization or a traffic signal.

(3) Intersections With Left-Turn Channelization

Illumination of the intersection area and the left-turn storage is required for intersections with painted or other low profile pavement markings such as raised pavement markings. When the channelization is delineated with curbs, raised medians or islands, illuminate the raised channelization from the beginning of the left-turn taper. Illumination of the secondary road intersecting the state highway can be beneficial to the motoring public. Funding and design, however, are the local agency's responsibility. Contact that agency to see if they are interested in participating.

(4) Intersections With Traffic Signals

All traffic signals on state highways are illuminated. The extent of illumination is the same as for intersections with left-turn channelization. Illumination of the crossroad is beneficial and participation of the local agency is desirable. In cities with a population under 22,500, the state may assume responsibility for illumination installed on signal standards.

(5) Railroad Crossings With Gates or Signals

Railroad crossings with automated gates or signals on state highways are illuminated if there is nighttime train traffic. Within the corporate limits of a city, illumination is the responsibility of that agency.

(6) Transit Flyer Stops

Illuminate the loading area of a transit flyer stop located within the limited access boundaries.

(7) Major Parking Lots

All parking lots with usage exceeding 50 vehicles during the nighttime peak hour are considered major parking lots. Provide an illumination design that will produce the light levels shown in Figure 840-6 for the parking area and bus loading zone. During periods of low usage at night, only security lighting is required. Provide an electrical circuitry design that allows the illumination system to be reduced to approximately 25% of the required light level.

(8) Minor Parking Lots

Minor parking lots have a nighttime peak hour usage of 50 or less vehicles. Provide security level lighting for those lots owned and maintained by the state. Security lighting consists of lighting the entrance and exit to the lot.

(9) Truck Weigh Sites

Provide illumination of the scale platforms, parking areas, and inspection areas of weigh sites.

(10) Midblock Pedestrian Crossings

Illuminate the entire midblock pedestrian crossing, including the crosswalks, the refuge area in the roadway, and the sidewalks or shoulders

adjacent to the crosswalk. When a raised median pedestrian refuge design is used, illuminate this raised channelization.

(11) Long Tunnels

Long tunnels have a portal to portal length greater than the stopping sight distance. Provide both nighttime and daytime illumination for long tunnels.

840.05 Additional Illumination

At certain locations, additional illumination is desirable to provide better definition of nighttime driving conditions or to provide consistency with local agency goals and enhancement projects. For improvement projects, consider additional illumination on state highways where there is a diminished level of service or a nighttime accident frequency condition exists.

Diminished Level of Service is a mobility condition where the nighttime peak hour level of service is D or lower. When volumes are used to determine the level of service, use traffic counts taken during the evening peak hour. Peaking characteristics in urban areas are related to the time of day. Traffic counts taken in the summer between 4:30 p.m. and 7:30 a.m. may be used as nighttime volumes if adjustment factors for differences in seasonal traffic volumes are applied for November, December, and January.

Nighttime Accident Frequency Condition

is when the number of nighttime accidents equals or exceeds the number of daytime accidents. An engineering study that indicates illumination will result in a reduction in nighttime accidents is required to demonstrate justification. Consider the seasonal variations in lighting conditions when reviewing reported accidents. Accident reporting forms, using a specific time period to distinguish between “day” and “night,” might not indicate the actual lighting conditions at the time of an accident. Consider the time of year when determining if an accident occurred at nighttime. An accident occurring at 5:00 p.m. in July would be a daytime accident, but an accident occurring at the same time in December would be during the hours of darkness.

The mitigation of high nighttime, pedestrian accident locations requires different lighting strategies than vehicular accident locations. Provide light levels to emphasize crosswalks and adjacent sidewalks. Multiple lane highways with two-way left-turn lanes, in urban build up areas, are typically high speed facilities with numerous road approaches. These roadways allow numerous vehicle entry and exit points and provide few crossing opportunities for pedestrians. Additional illumination may be justified for this condition.

Document the justification for the additional illumination in the Design Documentation Package (DDP).

(1) Highways

Proposals to provide full (continuous) illumination require approval of the State Traffic Engineer. Regions may choose to develop system plans (regional or corridor specific) for providing full (continuous) illumination. The approval of a system plan will eliminate the need for a project specific approval.

The decision whether to provide full (continuous) illumination is to be made in the scoping stage and communicated to the designers as soon as possible.

(a) On the main line of full limited access highways, consider full (continuous) illumination if a diminished level of service exists and any two of the following conditions are satisfied:

- There are three or more successive interchanges with an average spacing of 1½ miles or less measured from the center of each interchange or a common point such as major cross roads.
- The segment is in an urban area.
- The nighttime accident frequency condition exists.
- A benefit cost analysis between the required and full (continuous) illumination.

(b) On the main line of highways without full access control, consider full (continuous) illumination if the segment of highway is in a commercial area and either a diminished level of

service exists or the nighttime accident frequency exists and an engineering study indicates that nighttime driving conditions will be improved.

(2) Ramps

At ramps, consider additional illumination when a diminished level of service exists for the ramps and any of the following conditions are present:

- The ramp alignment and grade are complex.
- There are routine queues of five or more vehicles per lane at the ramp terminal due to traffic control features.
- The nighttime accident frequency condition exists.
- The criteria for continuous mainline illumination have been satisfied.

(3) Crossroads

At crossroads, consider additional illumination when a diminished level of service exists and the nighttime accident frequency exists. Also, consider additional illumination if the crossroad is in a tunnel, undercrossing, or lid.

(4) Intersections Without Channelization

Consider illumination of intersections without channelization in urban areas and other locations if a nighttime accident frequency requirement is satisfied or the traffic volumes and movements would be improved with the installation of left turn channelization.

(5) Tunnels, Underpasses, or Lids

Consider illumination of tunnels, underpasses or lids if portal conditions result in a brightness in the tunnel that is less than the measured daytime brightness of the approach roadway divided by 15 and the length to vertical clearance ratio is 10:1 or greater.

(6) Construction Zones and Detours

Consider illumination of construction zones and detours under the following conditions:

- if construction activities take place on the roadway at night.

- when traffic flow is split around an obstruction.
- for detours, where the alignment and grade are unusual and require additional driver, cyclist, or pedestrian alertness.

(7) Transit Stops

The responsibility for lighting at transit stops is shared with the transit company. Consider illumination of transit stops with shelters, as this generally is indicative of higher passenger usage. Negotiation with the transit agencies is required for the funding and maintenance of this illumination. If the transit agency is unwilling to participate in the funding and maintenance of the illumination, a single light standard positioned to illuminate both the transit pullout area and the loading area can be considered.

(8) Bridges

Justification for illuminating bridges is the same as that for highways with or without full limited access control, as applicable.

(9) Railroad Crossing Without Gates or Signals

Illumination of these facilities is justified if there is a potential for nighttime accidents. Consider the extent of nighttime train activity in making this determination. Also, consider illumination if there is a probability that railroad cars will be stopped on the crossing during the nighttime.

(10) Walkways and Bicycle Trails

Illumination of pedestrian walkways is justified if the walkway is a connection between two highway facilities. This might be between parking areas and rest room buildings at rest areas, between drop-off or pick-up points and bus loading areas at flyer stops, or between parking areas and bus loading areas or ferry loading zones, for example. Consider illuminating existing walkways and bicycle trails if security problems have been reported. Also, consider illumination if security problems are anticipated. In these conditions the walkways and bicycle trails are illuminated to the level shown in Figure 840-6.

(11) Rest Areas

Provide illumination at the roadway diverge and merge sections within rest areas and the parking areas as for a major parking lot.

840.06 Design Criteria

(1) Light Levels

Light levels vary with the class of highway, development of the adjacent area, and the level of nighttime activity. Light level requirements for highways and other facilities are shown in Figure 840-6. These levels are the minimum average light levels required for a design area at the end of rated lamp life for applications requiring a spacing calculation. Light level requirements are not applicable for single light standard or security lighting installations. See Chapters 430 and 440 for design classes of highways.

The types of activity areas, shown below, are related to the number of pedestrian crossings. These crossings need not occur within a single crosswalk and can be at several locations along the roadway in an area with pedestrian generators. Land use and activity classifications are as follows:

- **High Activity.** Areas with over 100 pedestrian crossings during the nighttime peak pedestrian hour usage. Examples are: downtown retail areas, near stage theaters, concert halls, stadiums, and transit terminals; and parking areas adjacent to these facilities.
- **Medium Activity.** Areas with pedestrian crossings that number between 11 and 100 during the nighttime peak pedestrian hour usage. Examples are: downtown office areas, blocks with libraries, movie theaters, apartments, neighborhood shopping, industrial buildings, and older city areas; and streets with transit lines.
- **Low Activity.** Areas with pedestrian crossings that number less than 11 during the nighttime peak pedestrian hour usage. Examples are suburban single family areas, low density residential developments, and rural or semirural areas.

(2) Design Areas

The design area is that portion of the roadway, parking lot, or other facility that is subject to the minimum light level, minimum average light level, uniformity ratio, and maximum veiling luminance ratio design requirements. This encompasses the area between the edges of the traveled way along the roadway; the outer edges of the stopping points at intersections; and, when present, a bike lane adjacent to the traveled way. When the roadway has adjacent sidewalks, the design area includes these features.

Design area requirements for various applications are shown in Figures 840-1 through 840-5 and the following:

- One-lane off-ramp. Two main line through lanes and the ramp lane, including gore area, from the gore point to a point 200 ft (minimum) down stream of the gore point. A 100 ft longitudinal tolerance either way from the gore point is allowed.
- Two-lane off-ramp. Two main line through lanes and both ramp lanes, including gore area, from a point 200 ft upstream of the gore point to a point 200 ft downstream from the gore point. A 100 ft longitudinal tolerance either way from the gore point is allowed.
- One-lane on-ramp. Two main line through lanes and the ramp lane, from a point where the ramp lane is 10 ft wide to a point 200 ft upstream. A 100 ft longitudinal tolerance either way is allowed. This includes auxiliary lane on connections and lane reductions.
- Two-lane on-ramp. Two main line through lanes and the ramp lanes from a point where the ramp lanes are 22 ft wide to a point 200 ft upstream. A 100 ft longitudinal tolerance either way is allowed.
- Intersections channelized with pavement markings. The design area has two components, the intersection area and the approach areas. The intersection area is the area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks. The

approach areas are the areas on the main roadway between the stopping point and where the left-turn lane is full width.

- Intersections with raised channelization. The design area has two components, the intersection area and the approach areas. The intersection area is the area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks. The approach areas are the areas on the main roadway between the stopping point and where the left-turn taper begins.
- Unchannelized intersection. The area between the stopping points on both the main road and the minor road, including marked or unmarked crosswalks.
- Railroad crossings. The roadway width from a point 50 ft either side of the track (the approach side only for one way roadways).
- Transit loading areas. The lane width and length designated for loading.
- Major parking lots. The entire area designated for parking including internal access lanes.
- Scale platforms at weigh sites. The approach width from the beginning of the scale platform to the end of the platform.
- Inspection areas at weigh sites. The area dedicated to inspection as agreed upon with the Washington State Patrol.

(3) Light Levels for Tunnels and Underpasses

Short tunnels and underpasses, with a length to vertical clearance ratio of 10:1 or less, normally do not have daytime illumination. Short tunnels with length to vertical clearance ratios greater than 10:1 are treated the same as an entrance zone on a long tunnel to establish daytime light levels. Nighttime light level requirements for short tunnels on continuously illuminated roadways are the same as the light level required on the roadway outside the tunnel.

Long tunnels are divided into zones for the determination of daytime light levels. Each zone is equal in length to the wet pavement stopping

sight distance. The entrance zone beginning point is a point outside the portal where the motorist's view is confined to the predominance of the darkened tunnel structure.

The daytime entrance zone light level is dependent upon the brightness of the features within the motorist's view on the portal approach. The brightness level is defined as the average brightness measured over a 20 degree cone at a point 500 ft in advance of the portal. The entrance zone light level produced within the tunnel must be sufficient to provide a brightness level of approximately 5% of the measured portal brightness, after adjustment for the reflectivity of the roadway, walls, and ceiling. Design successive zones for a daytime light level of 5% of the previous zone light level to a minimum value of 5 footcandles. Requirements for nighttime light levels for long tunnels on continuously illuminated roadways are the same as the light level required on a roadway outside the tunnel. Provide adequate illumination of fire protection equipment, alarm pull boxes, phones, and emergency exits in long tunnels to minimize the risk associated with catastrophic accidents.

(4) Light Standards

(a) **Light Standards.** Light standards are the most common supports used to provide illumination for highway facilities. The 40 ft and 50 ft high light standards with breakaway bases and Type 1 mast arms are used predominately on state highways. The angular Type 2 mast arms are allowed only to match existing systems. Use Type 1 mast arms on all new systems. Cities and counties may elect to use different mounting heights to address factors unique to their environments. On state highways, alternate light standards may be use if requested by the city or county, provided they agree to pay any additional costs associated with this change.

The typical location for a light standard is on the right shoulder. When considering designs that propose light standards mounted on concrete barrier in the median, consider the total life cycle cost of the system, including the user costs resulting from lane closures required for relamping and repair operations. Light standards

located in the vicinity of overhead power lines require a 10 ft clearance from the power line to any portion of the light standard or luminaire. Consult the [HQ](#) Bridge and Structures Office when mounting lights on structures such as retaining walls and bridge railings.

It is preferable to locate a light standard as far from the traveled way as possible to reduce the potential of impacts from errant vehicles. The length of the mast arm can vary from 6 ft to 16 ft to allow for this placement. The preferred position for the luminaire is over the edge line. However, some flexibility is acceptable with the luminaire position to allow for placement of the light standard. When necessary, the luminaire can be positioned up to 4 ft from the edge line. See Figure 840-7.

When light standards are located within the Design Clear Zone, breakaway features are used to reduce the severity of a potential impact. To allow these breakaway features to function as intended, it is preferred that they be installed on slopes that are 6H:1V or flatter (cut or fill slope). On fill slopes where flattening of the slope to achieve a 6H:1V slope is not practical, consider locating the light standard at least 12 ft beyond the slope break. If this is not possible, locate the light standard at the slope break. Do not place the light standard on a fill slope that is 3H:1V or steeper unless it is behind a traffic barrier.

When placing the light standard on a cut slope, that is 3H:1V or flatter (such as the backslope of a ditch), the preferred location is outside of the Design Clear Zone. If this is not practical, the light standard may be installed with a modified foundation that matches the slope's surface. In this case, it is critical that the light standard be positioned at least 4 ft beyond the bottom of the ditch. Locate light standards on slopes steeper than 3H:1V outside of the Design Clear Zone. Even when located beyond the Design Clear Zone, it is desirable to use a breakaway base if there is a possibility it could be struck by an errant vehicle.

In curb and sidewalk sections, locate the light standard behind the sidewalk.

Breakaway bases on light standards are a safety requirement for higher speed roadways. They are not always desirable at other locations. Locations where fixed bases are installed are:

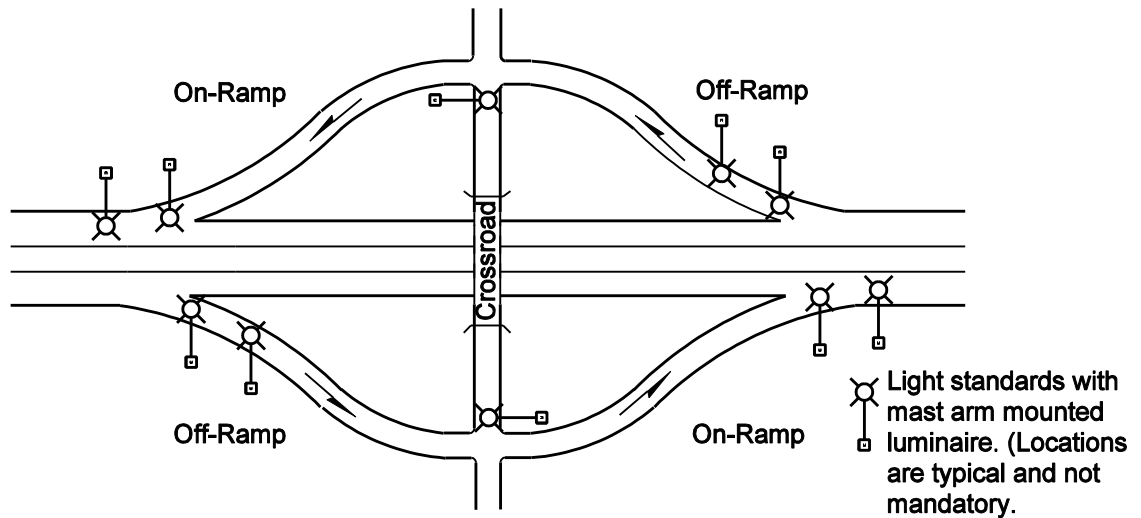
- Parking lots.
- Medians where the light standard is mounted on median barrier.
- Behind traffic barrier, beyond the barrier's deflection design value (See Chapter 710).
- Along highways with posted speeds of 35 mph or less where there is medium or high pedestrian activity.
- Pedestrian walkways, bike paths, and shared use paths.

(b) **Light Standard Heights.** Unusual pole heights require longer fabrication time and are not recommended. Use pole heights of 40 ft and 50 ft for roadway illumination. These pole heights will result in variable mounting heights for the luminaires. Use the actual mounting height at each location when calculating light standard spacing. High mast light supports may be considered for complex interchanges where continuous lighting is justified. Initial construction costs, long term maintenance, clear zone mitigation, spill-over light on to adjacent properties, and negative visual impacts are important factors when considering high mast illumination. Shorter light standards of 30 ft or less may be used for minor parking lots, trails, pedestrian walkways, and locations with restricted vertical clearance.

(c) **Standard Luminaire.** The cobra head style, high pressure sodium vapor luminaire with Type III, medium cut-off light distribution is the normal light source used for state highway lighting. A Type III distribution has an oval pattern, and a Type V distribution has a circular pattern. Post top mounted luminaires and other decorative light fixtures with Type V patterns are more effective for area lighting in parking lots and other locations where more symmetrical light distribution patterns are preferred. Recommended mounting heights and initial lumens for various luminaire wattages are shown in Figure 840-8.

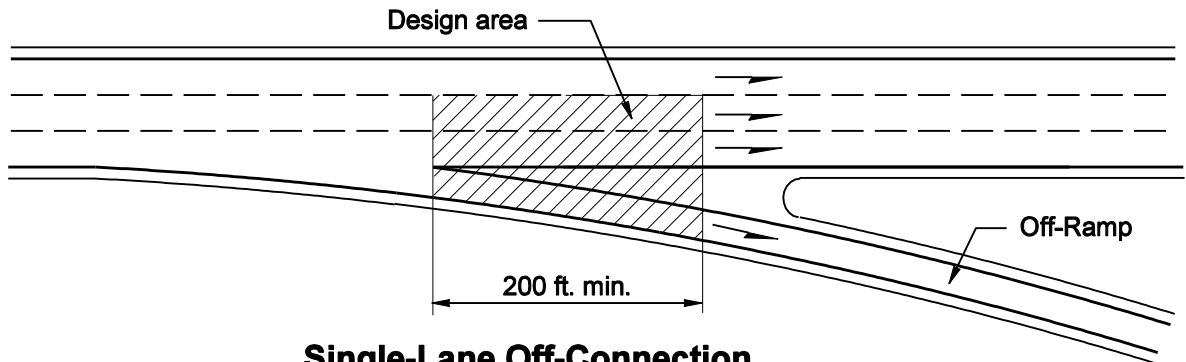
840.07 Documentation

A list of the documents that are to be preserved [in the Design Documentation Package (DDP) or the Project File (PF)] is on the following website: <http://www.wsdot.wa.gov/eesc/design/projectdev/>



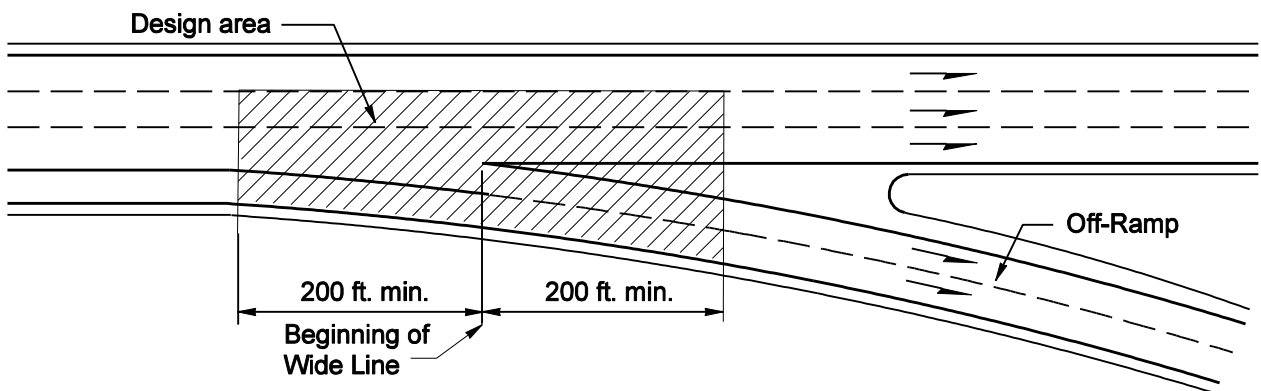
Required Illumination for a Typical Diamond Interchange

(Shown for single lane ramp connection and a two-lane crossroad without channelization.)



Single-Lane Off-Connection

(The design area can be shifted up to 100 ft. from the beginning of the Wide Line.)

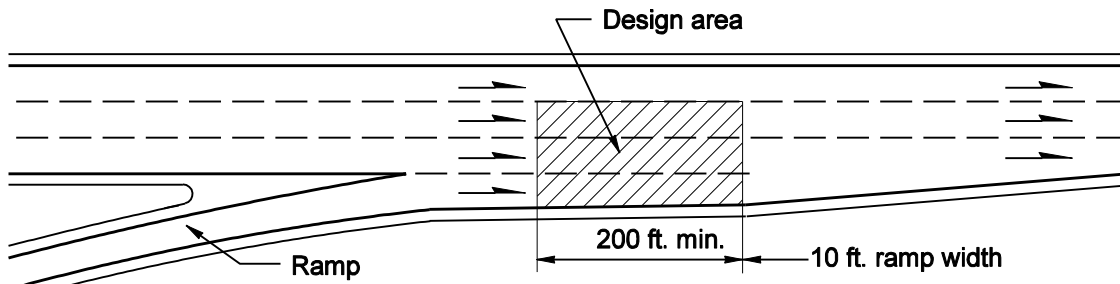


Two-Lane Off-Connection

(The design area can be shifted up to 100 ft. from the beginning of the Wide Line.)

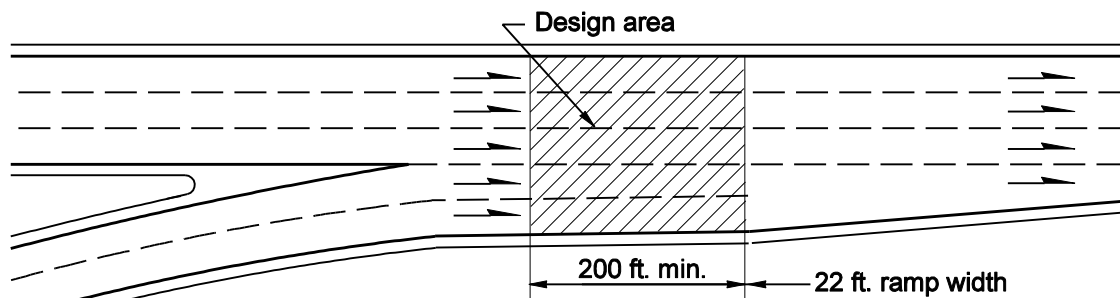
Freeway Lighting Applications

Figure 840-1



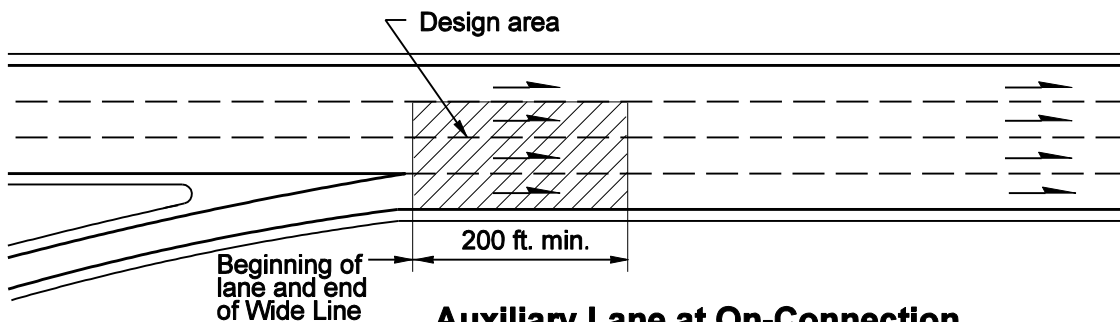
Single-Lane On-Connection

(The design area can be shifted up to 100 ft. from the 10 ft. wide ramp point.)



Two-Lane On-Connection

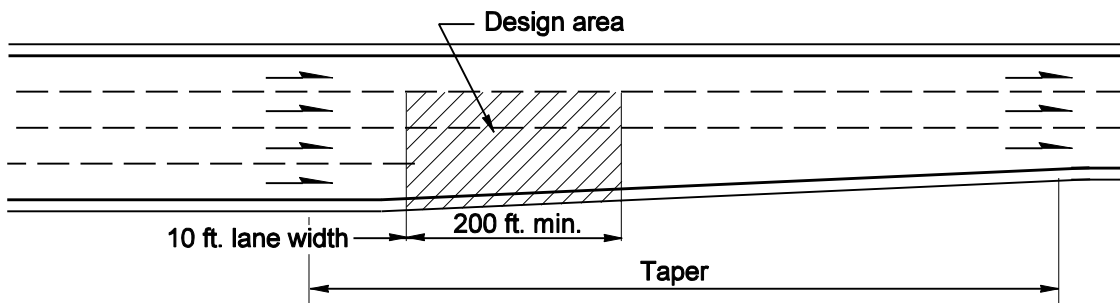
(The design area can be shifted up to 100 ft. from the 22 ft. wide ramp point.)



Auxiliary Lane at On-Connection

(Required only if significant weaving problem exists.)

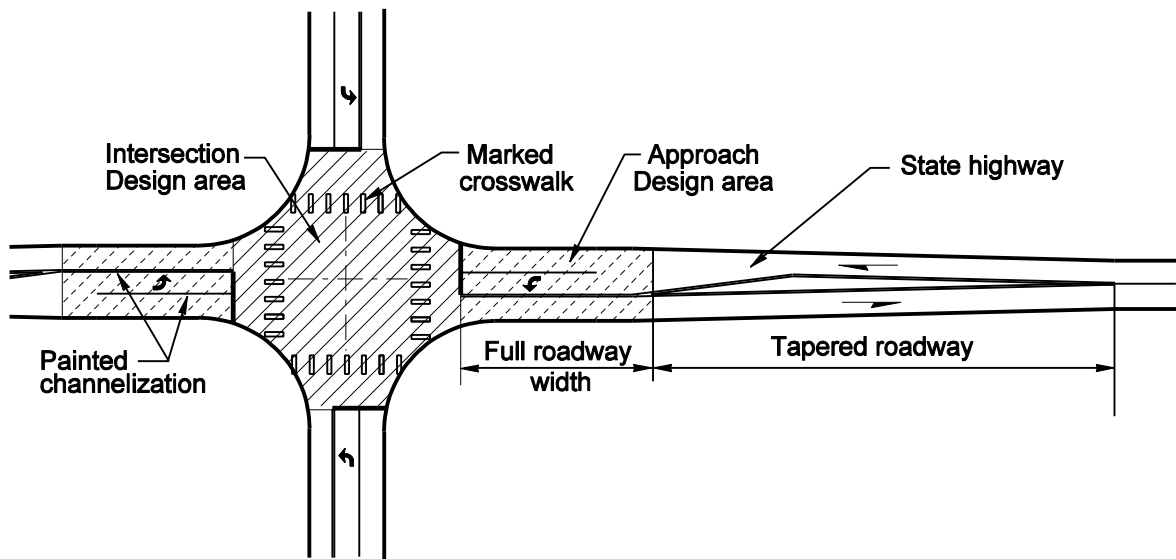
(The design area can be shifted up to 100 ft. from the 22 ft. wide ramp point.)



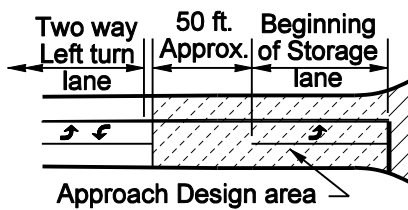
Lane Reduction

Freeway Lighting Applications

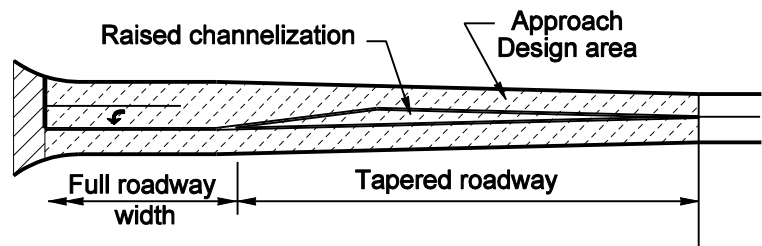
Figure 840-2



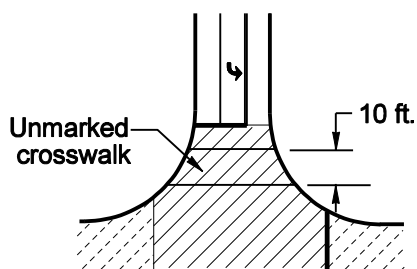
Intersection with Left-Turn Channelization



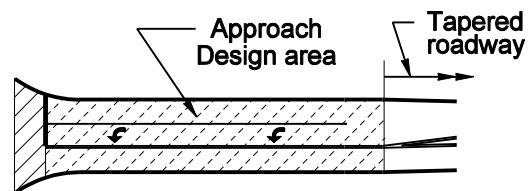
Alternate for Transitions to Two-Way Left-Turn Lanes



Alternate for Raised Channelization

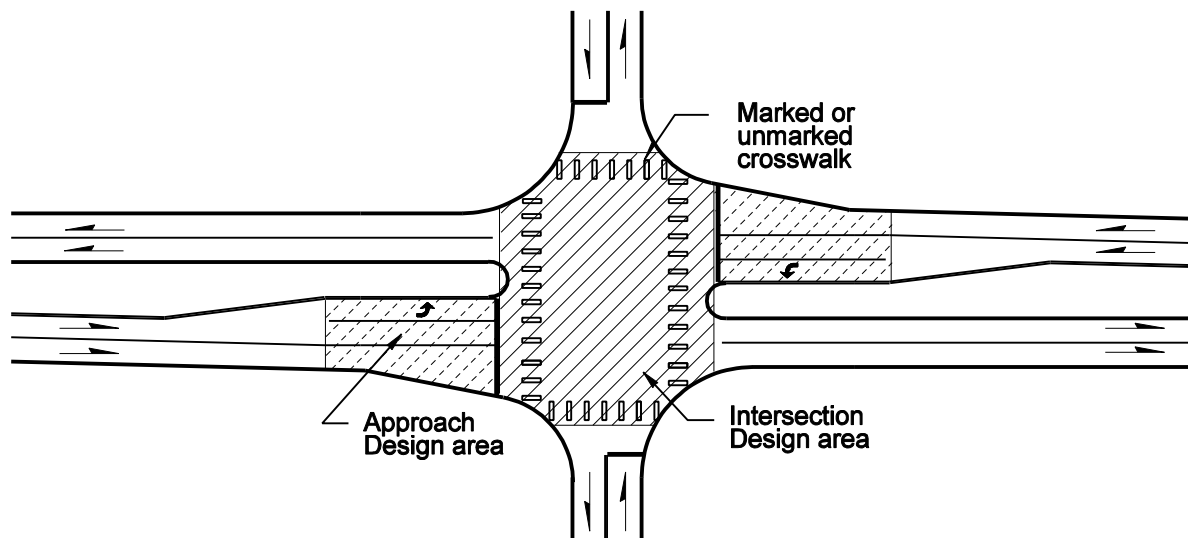


Unmarked Crosswalk Detail

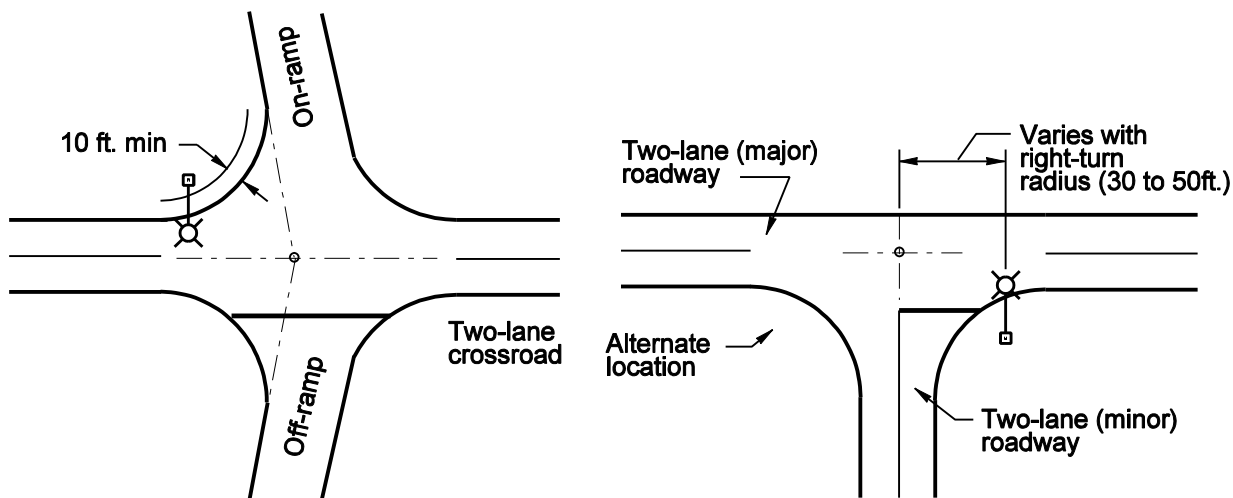


Alternate for Long Storage Lanes

Roadway Lighting Applications
Figure 840-3



Divided Highway Intersection

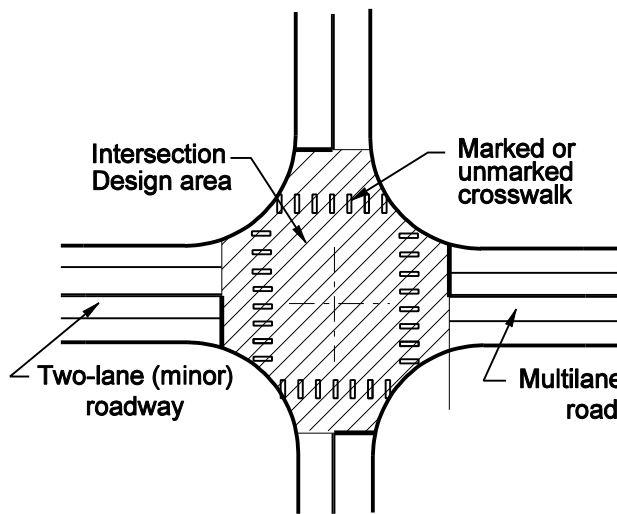


Ramp Terminals

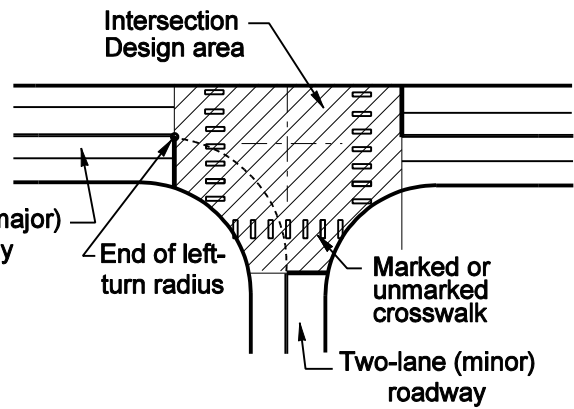
Tee Intersection Minor
(Without left-turn channelization)

Light standards with mast arm mounted luminaire. (Locations are typical and not mandatory.)

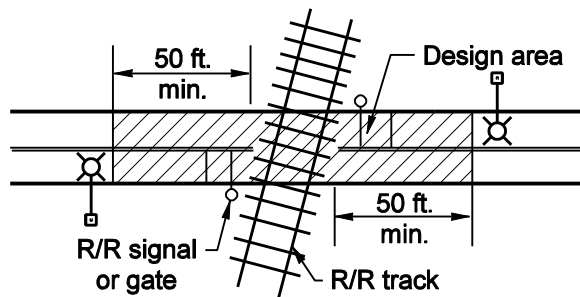
Roadway Lighting Applications
Figure 840-4



Four Way Intersection
(Without left-turn channelization)



Tee Intersection Major
(Without left-turn channelization)



Railroad Crossing

Roadway Lighting Applications

Figure 840-5

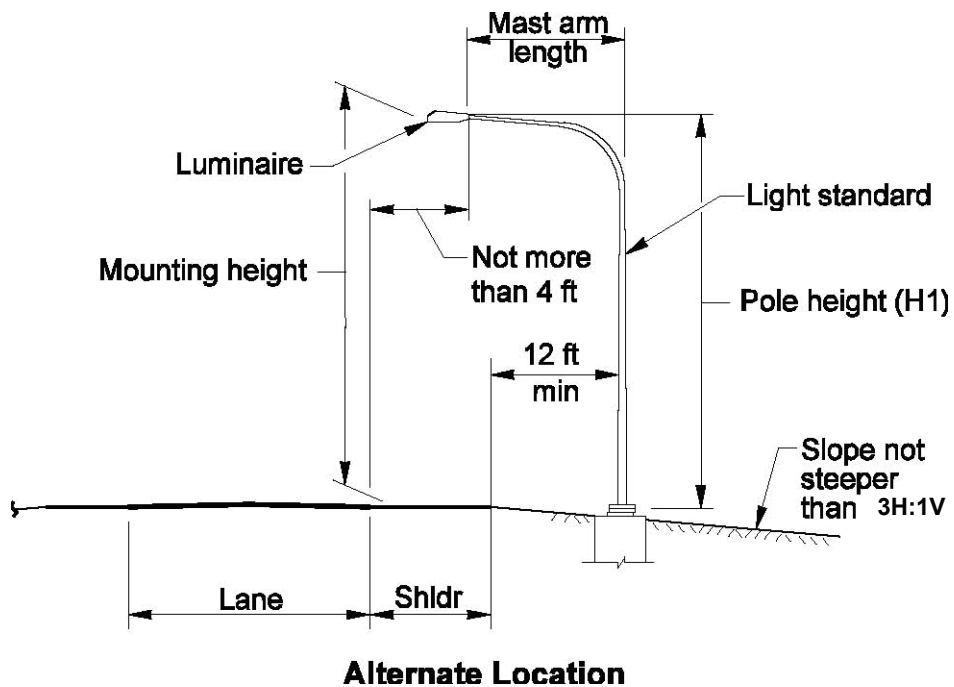
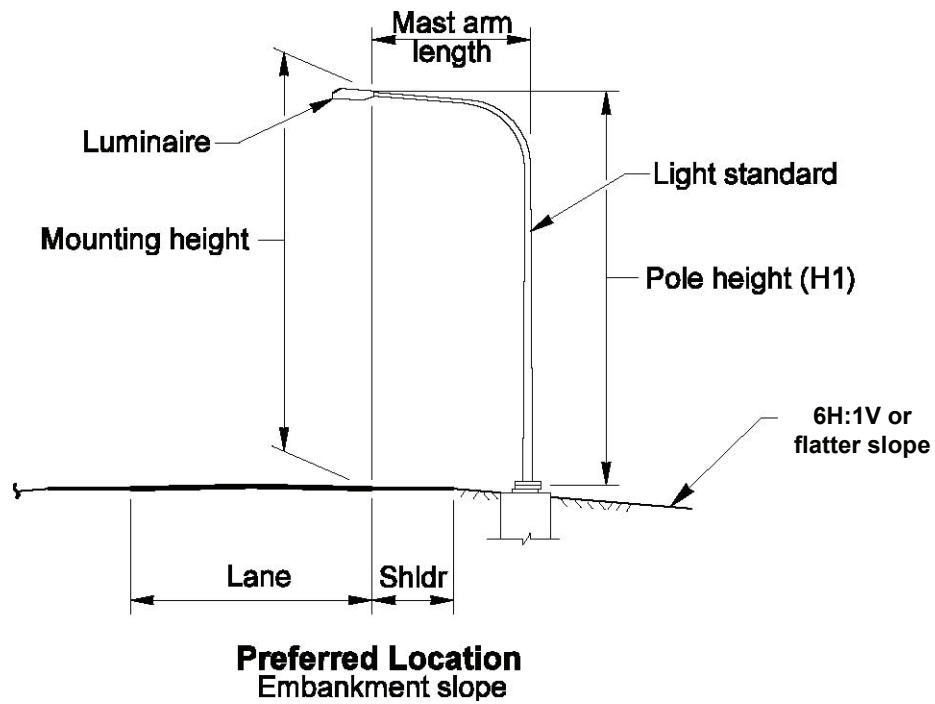
Light Level and Uniformity Ratio Chart					
Highway Design Class	Average Maintained Horizontal Light Level (2)			Maximum Uniformity Ratio (6)	Maximum Veiling Luminance (7)
	Pedestrian/Area Classification				
	High (footcandles)	Medium (footcandles)	Low (footcandles)		
Highways with Full Limited Access Control (1)					
Main Line	0.6	0.6	0.6	4 : 1	0.3 : 1
Ramps	0.6	0.6	0.6	4 : 1	0.3 : 1
Crossroads	0.6	0.6	0.6	3 : 1	0.3 : 1
Ramp Intersections	0.9	0.9	0.9	3 : 1	0.3 : 1
Principal Arterials (3)					
Main Line	1.6	1.2	0.6	3 : 1	0.3 : 1
Intersections	1.6	1.2	0.9	3 : 1	0.3 : 1
Minor Arterials					
Main Line	1.2	0.9	0.6	3 : 1	0.3 : 1
Intersections	1.2	0.9	0.9	3 : 1	0.3 : 1
Collectors					
Main Line	1.1	0.8	0.6	3 : 1	0.3 : 1
Intersections	1.1	1.0	0.9	3 : 1	0.3 : 1
Construction Lanes and Detours	1.0	1.0	1.0	3 : 1	0.3 : 1
Parking Lots / Rest Areas (5)	0.8	0.8	0.8	3 : 1	0.3 : 1
Vehicle Inspection Areas	2.0	2.0	2.0	3 : 1	0.3 : 1
Walkways and Bicycle Trails	0.8	0.8	0.8	3 : 1	0.3 : 1
Weigh Scales	0.8	0.8	0.8	3 : 1	0.3 : 1
Transit Stops (4)	2.0	2.0	2.0	NA (8)	0.3 : 1

Notes

- (1) The minimum light level is 0.2 fc for any application with an average light level of 0.6 fc. The minimum light levels for all other applications are controlled by the uniformity ratio.
- (2) Light level and uniformity ratio apply only when installation of more than one light standard is justified.
- (3) Light levels shown also apply to modified and partial limited access control.
- (4) For single light standard installations, provide the light level at the location where the bus stops for riders. (See 840.05 (6))
- (5) Includes illumination at ramp on and off connections.
- (6) $\frac{\text{Average Light Level}}{\text{Minimum Light Level}}$
- (7) $\frac{\text{Maximum Veiling Luminance}}{\text{Average Luminance}}$
- (8) Uniformity ratio is 3:1 when more than one light standard is justified.

Light Levels and Uniformity Ratios

Figure 840-6



Light Standard Locations
Figure 840-7

Luminaire Wattage	Initial Lumens*	H1	Recommended	
			Mounting Height	
			Maximum	Minimum
200	22,000	30 ft	32 ft	28 ft
250	28,000	35 ft	38 ft	32 ft
310	37,000	40 ft	44 ft	36 ft
400	50,000	40 ft	44 ft	36 ft
400	50,000	50 ft	54 ft	46 ft
1,000	140,000	100 ft	110 ft	90 ft

Note:

*Lumens are for high pressure sodium vapor luminaires

Luminaire Wattage, Lumens, and Mounting Heights
Figure 840-8